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An Ocean Sensor Array to Detect Small-Scale Variability

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LONG-TERM GOALS

The long-term goal of this DURIP award is to develop an ocean sensor array designed to directly measure the small-scale variability in currents and properties over the full depth of the water column, and relate this to the large-scale flow in which it is embedded. The ocean sensor array, consisting of bottom mounted Acoustic Doppler Current Profilers (ADCPs) and temperature-conductivity sensors, is proposed for deployment in the Mindoro (sill depth ~400 m) and the Tablas Strait (sill depth ~ 350 m) in the Philippines as part of the ONR DRI “Characterization and Modeling of Archipelago Strait Dynamics”.

OBJECTIVES

The specific objectives are to provide direct measurements of velocity and currents in narrow straits with shallow sill depths in order to:

1. characterize the spatial and temporal variability of the small-scale features,
2. determine their relationship to the large-scale background flow,
3. examine how they may vary seasonally as the remote and local forcing changes .

Ultimately, this will effort will provide a long-term context for the ship-borne, synoptic-type measurements during the DRI’s Intensive Observing Phase (IOP) and furthermore, enable a better representation and prediction in numerical and theoretical models in a region that has no previous subsurface oceanographic measurements.

APPROACH

Strong tidal currents and relatively shallow sills in narrow straits lead to a variety of small-scale processes such as upwelling/downwelling, island and sidewall wakes, internal waves and other localized turbulent circulation patterns. These dynamics produce strong fluctuations in the currents and stratification that directly impact small vessel and AUV operation and induce turbulence that can modify acoustic signal propagation. The ocean sensor array is designed to directly measure this small-scale variability in currents and properties. The array consists of 2 RD Instruments Long Ranger 75 kHz Acoustic Doppler Current Profilers that provide direct current measurements (ADCPs), 4 Seabird SBE37SMs (conductivity and temperature) and 2 Seabird SBE39s (temperature) with pressure options to monitor mooring motions, and additional hardware of syntactic floatation and acoustic releases that

enable the deployment of these instruments. The instrumentation is designed to be deployed as a bottom-mounted mooring with the ADCPs in upward-looking mode. If placed in water-depths of 400 m, it is expected that these upward-looking ADCP instruments would provide full-depth velocity data at high enough vertical (~ 4 m) and temporal (0.25-0.5 hours) resolution to resolve the strong shear associated with the small scale features. In fact, given the strong tidal currents generally present in narrow straits with shallow sills, the use of conventional moorings is generally precluded, so that bottom mounted ADCPs are often the only feasible way to obtain long-term full-depth observations of the subsurface currents.

The ocean sensor array will be constructed and assembled by engineers and marine technicians at the Scripps Institution of Oceanography (SIO) Hydraulics Laboratory, under the guidance of Senior Development Engineer Mr Paul Harvey.

It is envisaged that the ocean sensor array will also provide temporal context for “synoptic” shipborne flow and property measurements, as well as provide ground-truthing of high frequency radar and SAR images, for other DoD funded researchers of the ONR DRI program, “Characterization and Modeling of Archipelago Strait Dynamics”. The high-frequency time series data will also provide a test for evaluating and refining of models and their predictions that are not possible from shipborne observations alone. This will enable better representation and prediction of the structure and evolution of the small-scale features.

WORK COMPLETED

Funding of this DURIP award was received in August 2006. To date our efforts have been directed towards purchasing the instrumentation from the manufacturers.

RESULTS

As noted above, funding for this award was only received last month and hence there are no significant results to date.

IMPACT/APPLICATIONS

All equipment purchased under the DURIP award will be placed in the SIO Hydraulics Laboratory Equipment Pool for access by all SIO personnel after the DRI Philippines deployment. Through this mechanism, the equipment offers the distinct potential for the enhancement of other field programs by all researchers and their students at SIO. Finally, the instrumentation funded as part of this DURIP may also open up new research capabilities: improved accuracy and resolution of currents and acoustical backscatter and the ability to make these sophisticated measurements in the surface mixed layer, bottom boundary layer and interfacial layers.

RELATED PROJECTS

The ocean sensor array is proposed for deployment in the Mindoro (sill depth ~ 400 m) and the Tablas Strait (sill depth ~ 350 m) in the Philippines as part of the ONR DRI “Characterization and Modeling of Archipelago Strait Dynamics”. The present IOP is planned for January 2008 through September 2008.